



US009638519B2

(12) **United States Patent**
Kwiatkowski et al.

(10) **Patent No.:** **US 9,638,519 B2**
(45) **Date of Patent:** **May 2, 2017**

(54) **METHOD FOR DETERMINING A CHANGE IN DISTANCE TO A MOVABLE AND REFLECTIVE TARGET BY MEANS OF INTERFEROMETER TO DETERMINE IF THE MOVEMENT OF THE REFLECTIVE TARGET IS REALLY EXECUTABLE**

(71) Applicant: **LEICA GEOSYSTEMS AG**,
Heerbrugg (CH)

(72) Inventors: **Tomasz Kwiatkowski**, Moosleerau
(CH); **Thomas Lüthi**, Aarau (CH)

(73) Assignee: **LEICA GEOSYSTEMS AG**,
Heerbrugg (CH)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/382,264**

(22) PCT Filed: **Feb. 28, 2013**

(86) PCT No.: **PCT/EP2013/054009**

§ 371 (c)(1),

(2) Date: **Aug. 29, 2014**

(87) PCT Pub. No.: **WO2013/127908**

PCT Pub. Date: **Sep. 6, 2013**

(65) **Prior Publication Data**

US 2015/0043007 A1 Feb. 12, 2015

(30) **Foreign Application Priority Data**

Mar. 1, 2012 (EP) 12157806

(51) **Int. Cl.**

G01C 1/04 (2006.01)

G01S 7/48 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **G01C 1/04** (2013.01); **G01B 9/02**
(2013.01); **G01B 11/14** (2013.01); **G01S 7/48**
(2013.01)

(58) **Field of Classification Search**

CPC G01S 57/48; G01S 57/4808; G01S 17/66;
G01S 17/42; G01S 17/89; G01B 11/14;
G01B 11/26; G01C 1/02; G01C 1/04
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,587,785 A * 12/1996 Kato G01P 3/366
356/28

6,062,216 A 5/2000 Corn
(Continued)

FOREIGN PATENT DOCUMENTS

CN 101189532 A 5/2008
DE 41 14 786 A1 11/1992

(Continued)

OTHER PUBLICATIONS

European Search Report dated Jul. 3, 2012 as received in Application No. EP 12 15 7806.

Primary Examiner — Michael P Lapage

(74) *Attorney, Agent, or Firm* — Maschoff Brennan

(57) **ABSTRACT**

Embodiments of the invention relate to a method for determining a change in distance to a moving and reflective target. Embodiments of the invention can be performed by means of interferometry and may include the generation of laser radiation, the emission of the measurement radiation to the target, and the detection of at least part of the measurement radiation reflected at the target. In some embodiments, a superposition of the reflected measurement radiation with the reference radiation is generated and detected, an interferometer output variable is derived on the basis of the detected superposition, and/or a time-resolved output variable

(Continued)

